EKF

TECHNICAL MANUAL

Molded case circuit breakers
AV POWER

AVERES

1 DESCRIPTION

The molded case circuit breaker AV POWER is designed for infrequent routine close/open operations and overload/short-circuit protection in the distribution networks and electric motors. The molded case circuit breakers are used in electrical installations at rated voltage of up to 690V AC, at frequency of 50 Hz, under currents from 10 to 1600 A.

The molded case circuit breakers are produced according to IEC 60947-2:2016.

Application area: protection of distribution networks and electric motors against the main parameters.

Types of trip units:

TM – Thermomagnetic trip unit;

ETU2.0 –electronic trip unit;

ETU2.2 – electronic trip unit (RS485 communication type);

ETU4.0 – electronic trip unit (LCD display);

ETU4.2 electronic trip unit (RS485 communication type).

ETU6.0 – electronic trip unit (LCD display);

ETU6.2 – electronic trip unit (RS485 communication type).

The molded case circuit breakers AV POWER can be equipped with accessories: shunt release, undervoltage release, auxiliary and alarm contacts, extended rotary handle and motor mechanism. Additionally, the ETU2. 2, ETU4.2, ETU6.2 electronic trip units are equipped with a communication module for data transfer to standard databusses. When using the ETU2. 2, ETU4.2, ETU6.2 electronic trip units, the remote control and protection circuits can be created as a part of the SCADA systems. For this purpose there are various communication modules and protocol converters. There are remote programming and indication panels for local control.

Accessories are not included in the delivery scope of the molded case circuit breakers AV POWER, except for the AV-TX2 communication module, which is included in the package with the ETU2.2 and ETU6.2 trip units.

The user purchases this equipment independently and completes the molded case circuit breaker AV POWER in accordance with the features of the protected object.

2 TECHNICAL DATA

Type code:

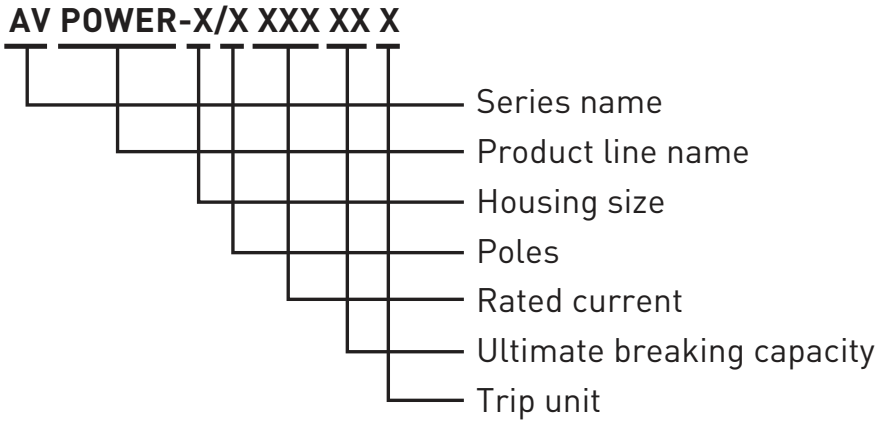


Table 1

AV POWER TM		**AV POWER-1**	**AV POWER-2**	**AV POWER-3**	**AV POWER-4**
Number of poles		3P/4P			
Rated current, In (A)		10, 16, 20, 25, 32, 40, 50, 63, 80, 100, 125, 140, 160	100, 125, 140, 160, 180, 200, 225, 250	250, 315, 350, 400, 500, 630	630, 700, 800
Rated insulation voltage, Ui (V)		AC800		AC1000	AC800
Rated impulse voltage, Uimp (kV)		8	8	12	8
Rated operational voltage, Ue (V)		AC400/AC690			
Rated ultimate breaking capacity, Icu (kA) AC 50/60 Hz	400 V	35/80		35/100	
	500 V	18/50		30/65	
	690 V	8/25		8/30	
Rated breaking capacity, Ics (кA) AC 50/60 Hz	400 V	35/75		35/80	
	500 V	12,5/40	20/50	20/50	20/40
	690 V	5/10	5,5/12,5	5,5/15	5,5/20
Utilization category		A			
Endurance (without maintenance)	mechanical	25 000		10 000	
	electrical	10 000		8 000	7 000
Power consumption, W		20	35	43	62

Continuation to table 1

AV POWER TM		AV POWER-1	AV POWER-2	AV POWER-3	AV POWER-4
Protection types					
Type of trip unit		TM	TM	TM	TM
Accessories					
Alarm contact		x	x	x	x
Auxiliary contact		x	x	x	x
Shunt release		x	x	x	x
Undervoltage release		x	x	x	x
Accessories	Outer connecting plates	x	x	x	x
	Interphase barriers	92/122	105/140	150/198	210/280
Size	Width, mm (3P/4P)	77/102 92/122(80 kA)	105/140	150/198	210/280
	Height, mm	130/155	165	257	275
	Depth, mm	61,5/79	73/90,5	103	105
Operating temperature, ° C		– 25 to + 40			

Table 2

AV POWER ETU		AV POWER-1	AV POWER-2	AV POWER-3	AV POWER-4	AV POWER-5
Number of poles		3P/4P				
Rated current, In (A)		32, 63, 100, 160	250	400, 630	1000	800, 1000, 1250, 1600
Rated insulation voltage, Ui (V)		AC800		AC1000	AC800	AC1000
Rated impulse voltage, Uimp (kV)		8	8	12	8	12
Rated operational voltage, Ue (V)		AC400/AC690				
Rated ultimate breaking capacity, Icu (kA) AC 50/60 Hz	400 V	50/100				70
	500 V	20/65	40/65			50
	690 V	10/30	30/40			25

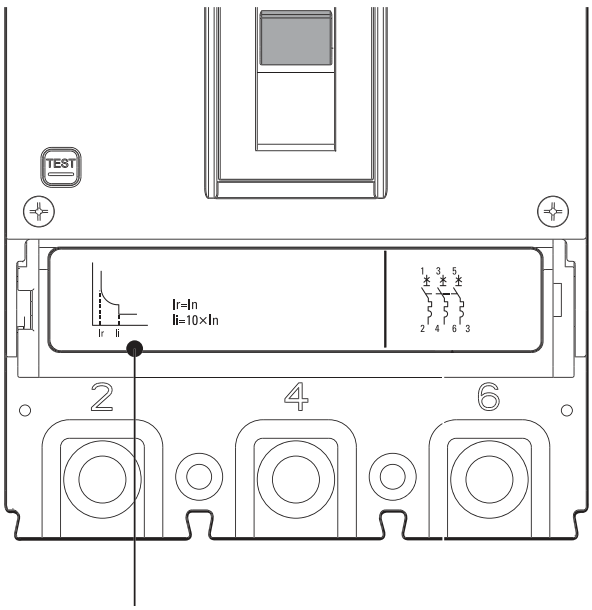
Continuation to table 2

AV POWER ETU		**AV POWER-1**	**AV POWER-2**	**AV POWER-3**	**AV POWER-4**	**AV POWER-5**
Rated breaking capacity , Ics (kA) AC 50/60 Hz	400 V	50/75				70
	500 V	20/40	40/65			50
	690 V	10/20	30/40			25
Utilization category		A		B		
Endurance (without maintenance)	me-chani-cal	25 000		10 000		
	elec-trical	10 000		8 000	7 000	3000
Power consumption, W		33	62	168	248	248
Type of protection						
Type of trip unit		Electronic trip unit				
Accessories						
Alarm contact		x	x	x	x	x
Auxiliary contact		x	x	x	x	x
Shunt release		x	x	x	x	x
Undervoltage release		x	x	x	x	x
Accessories	Outer connecting plates	x	x	x	x	x
	Interphase barriers	x	x	x	x	x
Sizes	Width, mm (3P/4P)	92/122	105/140	150/198	210/280	216/290
	Height, mm	155	165	257	275	288
	Depth, mm	79	90,5	103	105	155
Operating temperature, ° C		– 5 to + 40				

Table 3

Parameter	Value
Degree of protection on the side of front panel	IP30
Altitude above sea level, m	Up to 2000
Service life, not less than, years	15

2.1 Thermomagnetic trip unit (TM)



Protection curve

Fig.1

Table 4 - Characteristics

Rated current (A)	Tripping time (ambient air temperature + 40 °C)		Instantaneous tripping current (A)
	1.05In (cold) non-tripping time	1.3In (hot) tripping time	
In≤63	≥1 hour	<1 hour	10In ± 20%
63<In≤800	≥2 hours	<2 hours	

Housing dielectric strength factor against the altitude above sea level

Table 5

Parameter	**Value**				
Altitude above sea level	2000	2500	3000	4000	5000
Power-frequency withstand voltage (V)	3000	3000	2500	2200	2000
Insulation voltage	800	800	700	600	500
Maximum operational voltage (V)	690	690	600	500	440
Switching capacity adjustment factor	1	1	0,86	0,72	0,63
Operate current adjustment factor	1	1	0,95	0,95	0,9

Table 6 - Ambient temperature adjustment factor

Model	+40 °C	+45 °C	+50 °C	+55 °C	+60 °C
AV POWER-1	1,0 xIn	0,94 xIn	0,88 xIn	0,81 xIn	0,74 xIn
AV POWER-2	1,0 xIn	0,96 xIn	0,91 xIn	0,85 xIn	0,78 xIn
AV POWER-3	1,0 xIn	0,97 xIn	0,94 xIn	0,90 xIn	0,86 xIn
AV POWER-4	1,0 xIn	0,97 xIn	0,94 xIn	0,90 xIn	0,86 xIn

2.2 Electronic trip units

Table 7

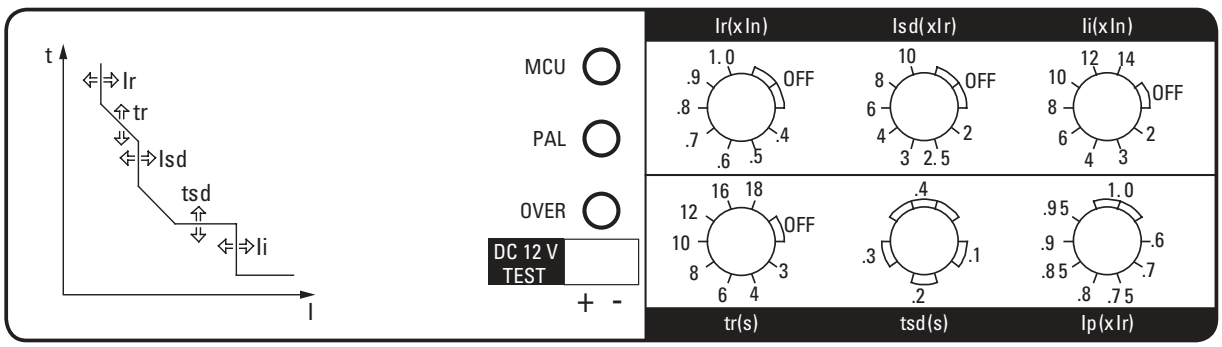
Controller model	**ETU 2.0**	**ETU 2.2**	**ETU 4.0**	**ETU 4.2**	**ETU 6.0**	**ETU 6.2**
Current protection	Overload protection, overload trip delay time setting. Short-circuit protection, short-circuit trip delay time setting. Instantaneous short-circuit protection. Earth leakage protection (optional)					
Other types of protection	Overload alarm does not trigger (on request). Neutral protection (optional). Phase imbalance protection (on request).					
Display	LED display		Digital display. Malfunction display			
Communication		Communication protocol Modbus-RTU. Interface: RS-485.		Communication protocol Modbus-RTU. Interface: RS-485.		Communication protocol Modbus-RTU. Interface: RS-485.

Continuation to table 7

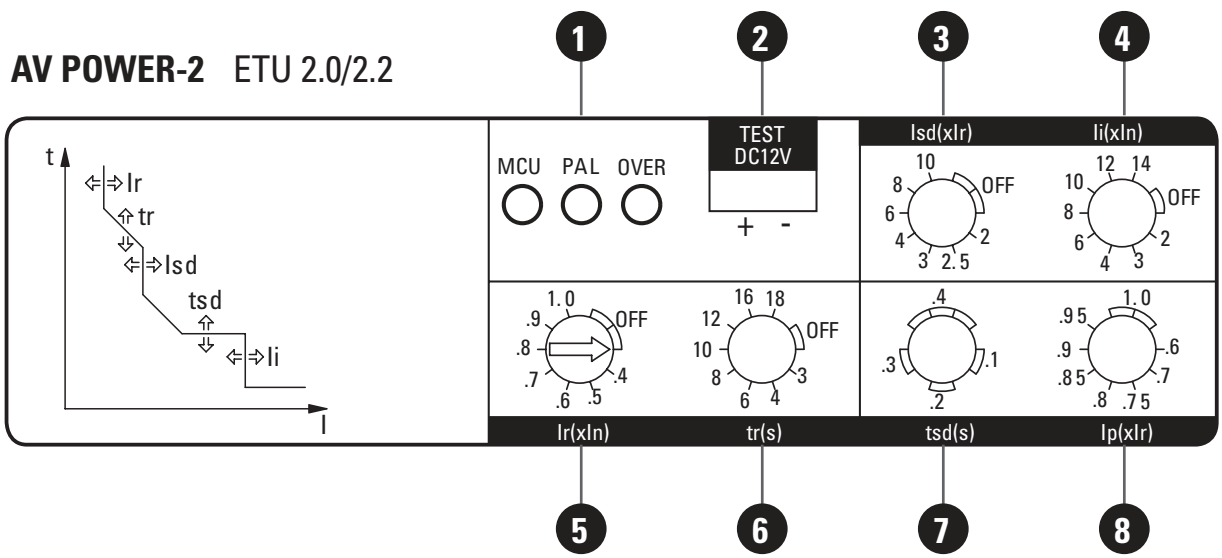
Controller model	ETU 2.0	ETU 2.2	ETU 4.0	ETU 4.2	ETU 6.0	ETU 6.2
Request					Request parameter, trouble shooting	
Function	Functional tests. Self-diagnostics					

2.2.1 Electronic trip unit ETU2.0/ETU2.2

AV POWER-1 ETU 2.0/2.2

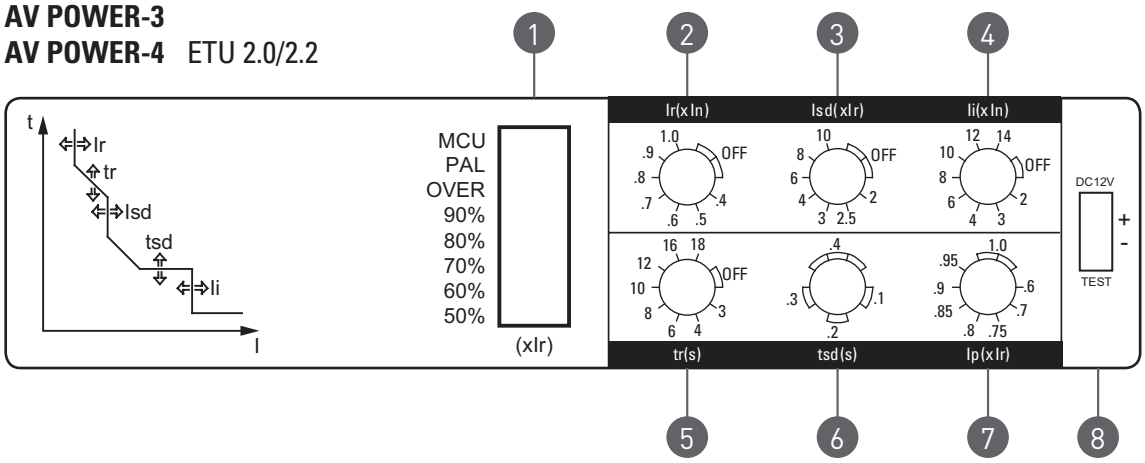


AV POWER-2 ETU 2.0/2.2



1. MCU – Operation LED light.
PAL – Pre-overload/fault LED light.
OVER – Overload LED light.
2. TEST- testing port: testing of controller.
3. Current setpoint Isd.
4. Instantaneous current setpoint Ii.
5. Thermal protection current setpoint Ir.
6. Overcurrent trip time delay setpoint.
7. Short-circuit current trip delay time setpoint.
8. Setting of pre-alarm/earth leakage protection Ip/Ig.

AV POWER-3
AV POWER-4 ETU 2.0/2.2



1. MCU –Green - trip unit power on
PAL – Pre-overload /fault LED light:
• Yellow lights up all the time is I⩾Ip
• Constant yellow light, if I⩾1.15Ir
Overload LED light:
OVER: Red constantly, I⩾Ir * 112%
90%: Yellow constantly, I⩾Ir * 90%
80%: Green constantly, I⩾Ir * 80%
70%: Green constantly, I⩾Ir * 70%
60%: Green constantly, I⩾Ir * 60%
50%: Green constantly, I⩾Ir * 50%
2. Thermal protection current setpoint Ir.
3. Current setpoint Isd.
4. Instantaneous current setpoint Ii.
5. Overcurrent trip delay time setpoint.
6. Short-circuit current trip delay time setpoint.
7. Setting of pre-alarm/earth leakage protection Ip/Ig.
8. TEST - testing port: testing of controller.

Table 8 - Overload protection, Ir

Overload breaking current setpoints Ir ± 10%		(0,4; 0,5; 0,6; 0,7; 0,8; 0,9; 1,0)xIn + OFF									
Tripping time Tp $T_r = \frac{(6I_r)^2}{I^2} t_r$	Electric current	Operate time									
	≤1.05Ir	During 2 hours of operation without tripping									
	1.3Ir	Tripping during one hour of operation									
	Value of the DIP setting	Setting the time factor, tr,c.u.	3	4	6	8	10	12	16	18	OFF
	I=1,5Ir	Tripping time, tr, sec	48	64	96	728	160	192	256	288	The alarm doesn't activate
	I=2Ir	Tripping time, tr, sec	27	36	54	72	90	108	144	162	
	I=6Ir	Tripping time, tr, sec	3	4	6	8	10	12	16	18	
	I=7Ir	Tripping time, tr, sec	2.08	2.77	4.17	5.55	6.94	8.33	11.1	12.5	

Table 9 - Protection against maximum currents

Breaking current value I_{sd} ± 10%		(2; 2,5; 3; 4; 5; 6; 8; 10)xIr + OFF				
Tripping time t_{sd} ± 15%	$I_{sd} \leq I < 1.5I_{sd}$	Dependence	$I^2T_{sd}=(1.5I_{sd})^2t_{sd}$			
Tripping time t_{sd}	$1.5I_{sd} \leq I < Ii$	Time setpoint t_{sd}, sec	0.1	0.2	0.3	0.4
		Acceptable deviation, sec	± 0,03	± 0,04	± 0,06	± 0,08

Table 10 - Instant short-circuit protection

Setpoint operating current Ii ± 15%	(2; 3; 4; 6; 8; 10; 12; 14)xIn + OFF
Break time ti, sec	0.05

Table 11 - Earth leakage protection

Earth leakage setpoint Ig, ± 10%	(0,2; 0,3; 0,4; 0,5; 0,6; 0,7; 0,8; 0,9; 1)In + OFF				
Tripping characteristics	I≤0.9Ig no tripping; I≥1.1Ig tripping				
Tripping time tg	Tripping time, sec	0.1	0.2	0.3	0.4
	Acceptable deviation, sec	± 0,03	± 0,04	± 0,06	± 0,08

Table 12 - Pre-alarm about overload

Current setting Ip	(0,6; 0,7; 0,75; 0,8; 0,85; 0,9; 0,95; 1,0)xIr
Operating characteristics	Alarm between 0.9xIp — 1.1xIp

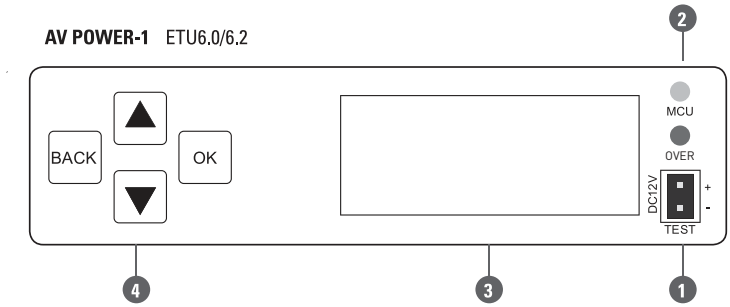
For the three-pole version, the overload pre-alarm function is included in the basic scope of delivery. For the four-pole version, the earth leakage protection function is included in the basic scope of delivery. Factory settings Ip = 0.9Ir.

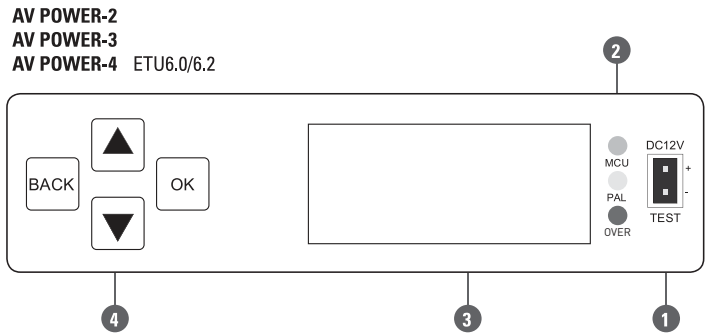
ETU-2.0 / ETU-2.2. Factory settings

Table 13

Protective characteristics			**Notes**
Protection against overload	Current setpoint Ir	1,0xIn	
	Delay time setpoint tr	18s	At I = 6Ir
Protection against overcurrent	Current setpoint Ir	6xIr	
	Delay time setpoint tr	0,1xs	At 1.5Isd≤I <Ii
Protection against short-circuit instantaneous currents	Current setpoint Ir	10xIn	
Earth leakage protection	Earth leakage current setpoint Ig	0,6xIn	
	Delay time setpoint tr	0,4s	
Pre-alarm	Pre-alarm current setpoint Ip	0,9xIr	0,4 s delay

2.2.2 Electronic trip unit ETU4.0/ETU4

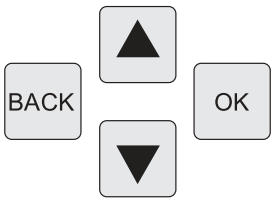




1. TEST – Testing port
2. MCU – Operation LED light
   PAL – Pre-overload/fault LED light
   OVER - Overload LED light
3. LCD display
4. Keys: «Cancel/Back»; «Down/Flip»; « Zoom in/Page»; «Setting /Confirm»

Select the submenu in the main menu.
Select the parameter in the submenu.
Change the parameter.

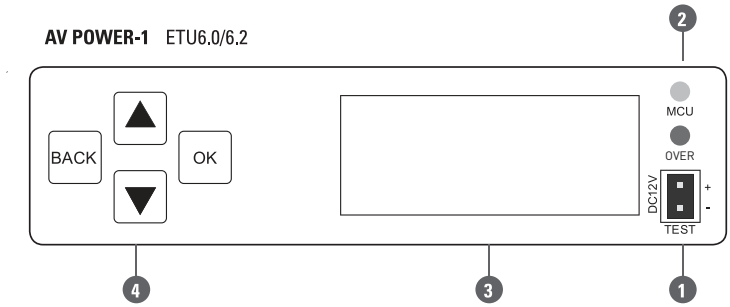
Return to the previous menu.
Return to the previous value
of the selected parameter.

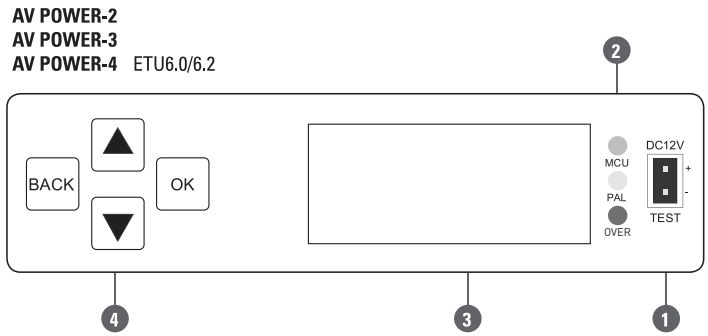


Select the current menu.
Move to the submenu.
Confirm the value
of the selected parameter.

Select the submenu in the main menu.
Select the parameter in the submenu.
Change the parameter.

2.2.3 Electronic trip unit ETU6.0/ETU6.2

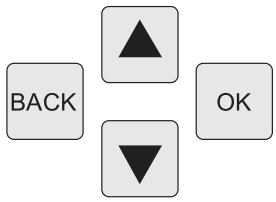




1. TEST – Testing port
2. MCU – Operation LED light
   PAL – Pre-overload/fault LED light
   OVER - Overload LED light
3. LCD display
4. Keys: «Cancel/Back»; «Down/Flip»; « Zoom in/Page»; «Setting/Confirm»

Select the submenu in the main menu.
Select the parameter in the submenu.
Change the parameter.

Return to the previous menu.
Return to the previous value
of the selected parameter.



Select the current menu.
Move to the submenu.
Confirm the value
of the selected parameter.

Select the submenu in the main menu.
Select the parameter in the submenu.
Change the parameter.

Table 14 - Overload protection, Ir

Overload breaking current setpoints Ir ± 10%		(0,4~ 1,0)xIn + OFF Minimal step 1A	
Tripping time Tp $T_r = \frac{(6 I_r)^2}{I^2} t_r$	Electric current	Operate time	
	≤1.05Ir	During 2 hours of operation without tripping	
	1.3Ir	Tripping during one hour of operation	
	6.0Ir	Time setting, sec	Minimal step 1 sec
	Thermal memory	10 min + OFF (reset when power is off)	ON/OFF

Table 15 - Protection against maximum currents

Breaking current value I_{sd} ± 10%		(2~10)xIr + OFF	
Tripping time t_{sd} ± 20%	$I_{sd} \leq I < 1.5 I_{sd}$	Dependence	$I^2 T_{sd} = (1.5 I_{sd})^2 t_{sd}$
Tripping time t_{sd}	$1.5 I_{sd} \leq I < Ii$	Time setpoint t_{sd}, sec	0,05-1 (minimal step 0,05 sec)
		Acceptable deviation, sec	± 15%
Thermal memory		5 min (can be disabled)	ON/OFF

Table 16 - Instant short-circuit protection

Setpoint operating current Ii ± 15%	(2-14)xIn + OFF (minimal step 1A)
Break time ti, sec	0.05

Table 17 - Earth leakage protection

Earth leakage setpoint ± 10%	(0,2~ 1)xIn + OFF (minimal step 1A)
Tripping characteristics	I≤0.9Ig no tripping; I≥1.1Ig tripping
Tripping time tg	0.1c ~ 0.8S + alarm (0.1 sec minimal step)

Table 18 - Pre-alarm about overload

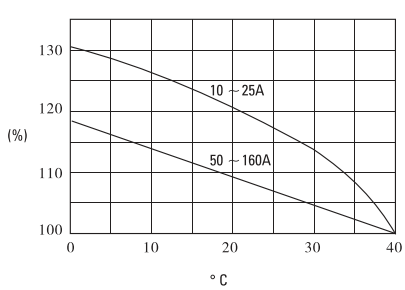
Current setting Ip	(0,6; 0,7; 0,75; 0,8; 0,85; 0,9; 0,95; 1,0)xIr
Operating characteristics	Alarm between 0.9xIp — 1.1xIp
	Delay time 0.1 ~ 1.0 sec
Asymmetry current	30-70%
	{Imax-Imin/Imax*100%} ⩽ no actions
	{(Imax-Imin)/Imax* 100%} > and Imax> Ir tripping with 10 sec delay

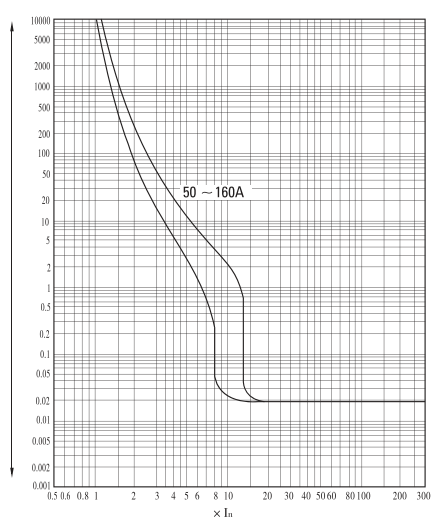
Table 19 - ETU-6.0/ETU-6.2. Factory settings

Protective characteristics			**Note**
Protection against overloads	Current setpoint Ir	1,0xIn	
	Delay time setpoint tr	18s	When I = 6Ir
Protection against overcurrent	Current setpoint Isd	6xIr	
	Delay time setpoint tsd	0,1xs	When 1.5Isd⩽I <Ii
Protection against short-circuit instantaneous current	Current setpoint Ii	10xIn	
Earth leakage protection	Earth leakage current setpoint Ig	0,6xIn	
	Delay time setpoint tg	0,4s	
Pre-alarm	Pre-alarm current setpoint Ip	0,9xIr	0,4 s delay

2.3 Tripping curves of the molded case circuit breakers

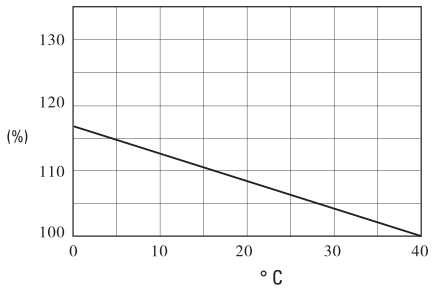
Thermomagnetic trip unit
POWER-1

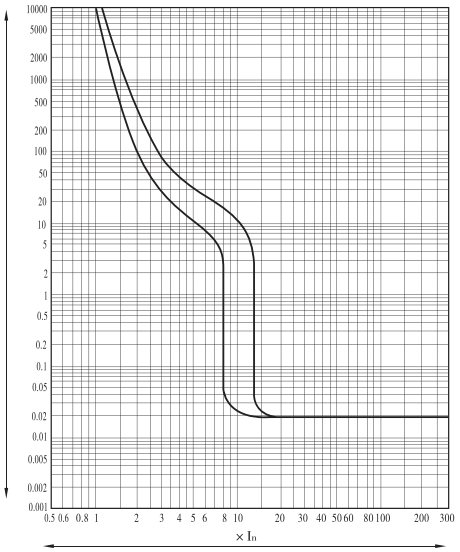




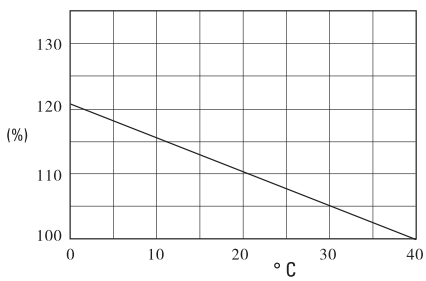
Note: short-circuit current breaking setpoint, ⩽50 A, is equal to 500 A ± 20%

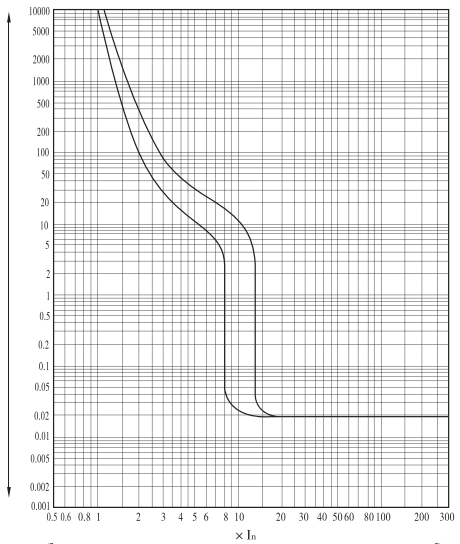
POWER-2



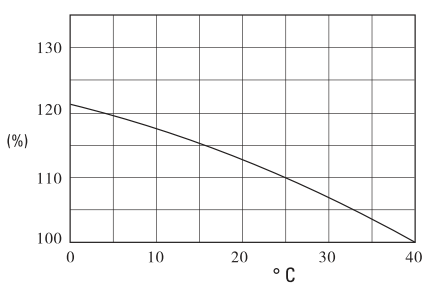


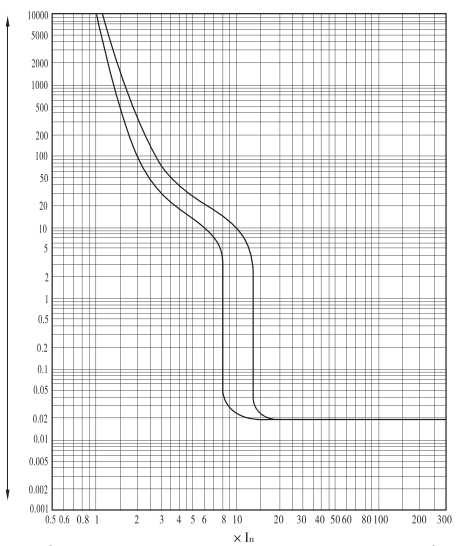
POWER-3



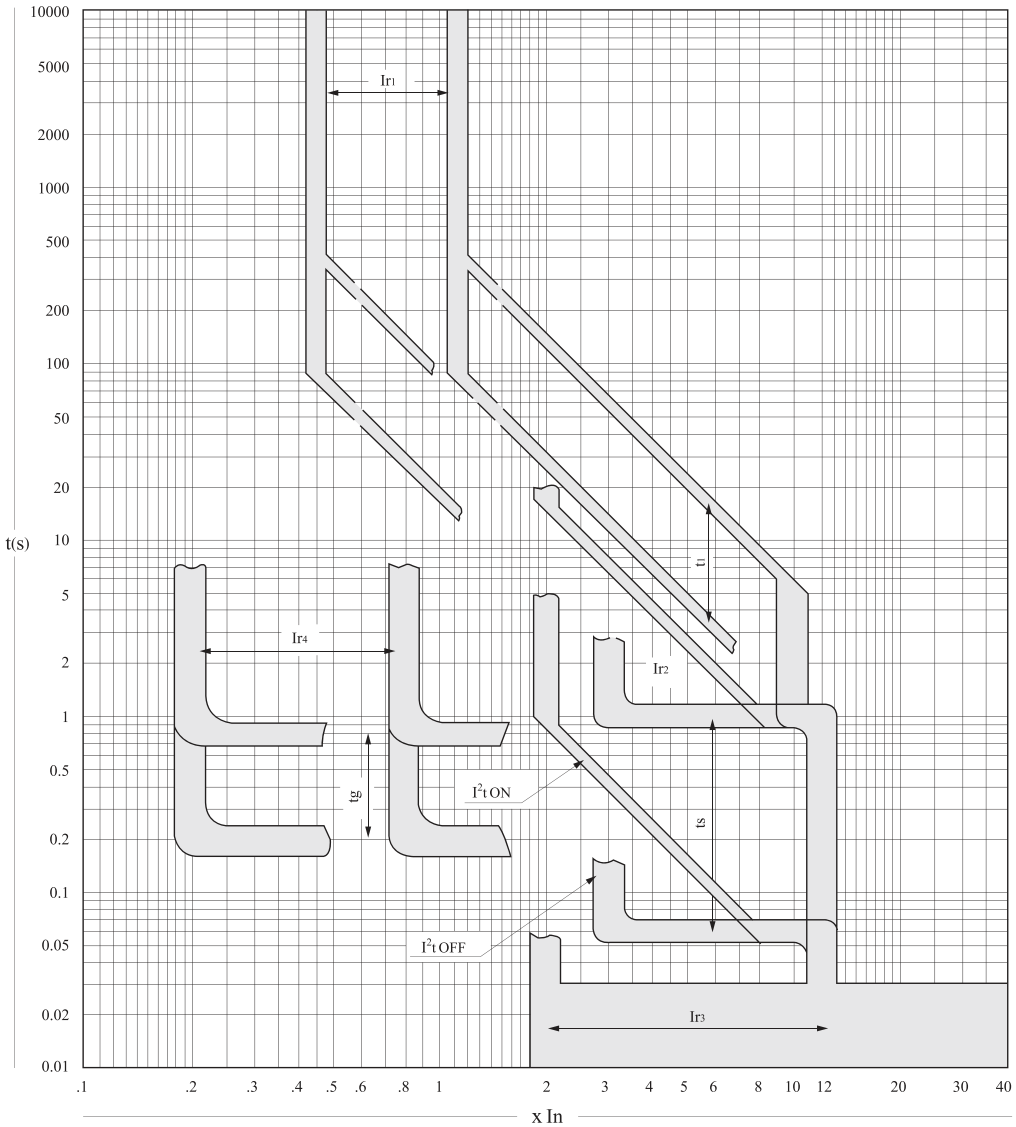


POWER-4





Electronic trip unit



3 COMMUNICATION EQUIPMENT

The molded case circuit breakers AV POWER with the electronic trip unit ETU can be combined into a communication network.

Additional modules are available to convert to different protocols, MODBUS to Profibus, DP.

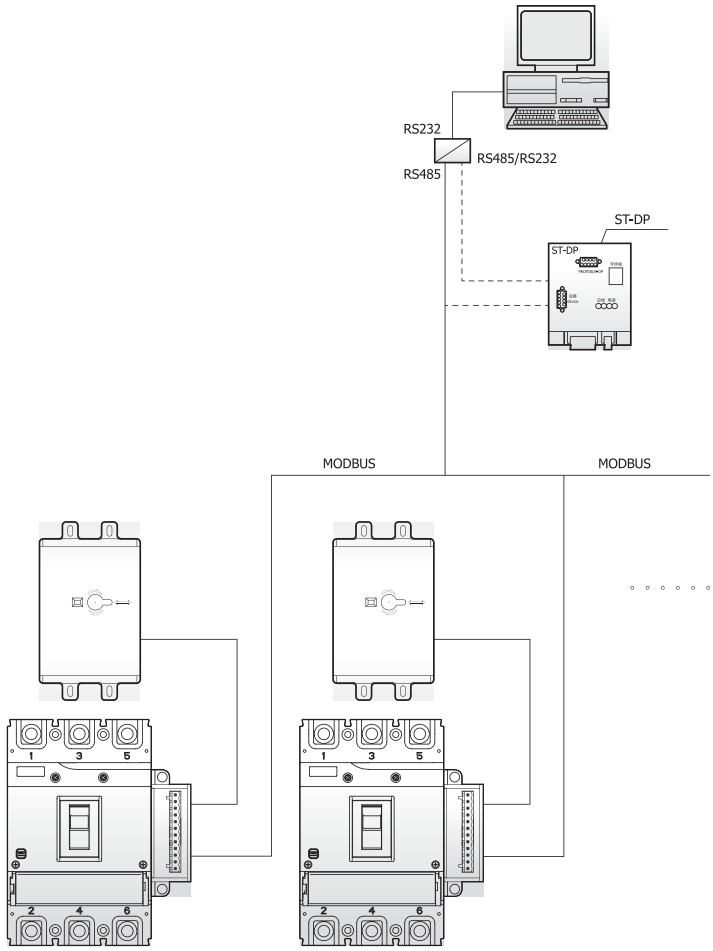


Fig. 2

The molded case circuit breaker AV POWER in conjunction with the electronic trip unit ETU can work with a communication interface, MODBUS communication interface.

The molded case circuit breaker AV POWER in conjunction with the electronic trip unit ETU can be connected off-line to the AV-CM display, which shows the current operating current of the molded case circuit breaker and the causes of tripping.

The molded case circuit breaker AV POWER in conjunction with the electronic trip unit ETU can be used for operation in a group communication network. It can be connected directly to the corresponding fieldbus, with various fieldbus protocols. Upon the request of the customer, the ST-DP protocol can be used.

The AV-DP conversion module converts the ST-DP protocol to MODBUS, and then connects to the data bus.

When setting parameters via the communication interface, the communication module has a higher priority.

4 OVERALL DIMENSIONS

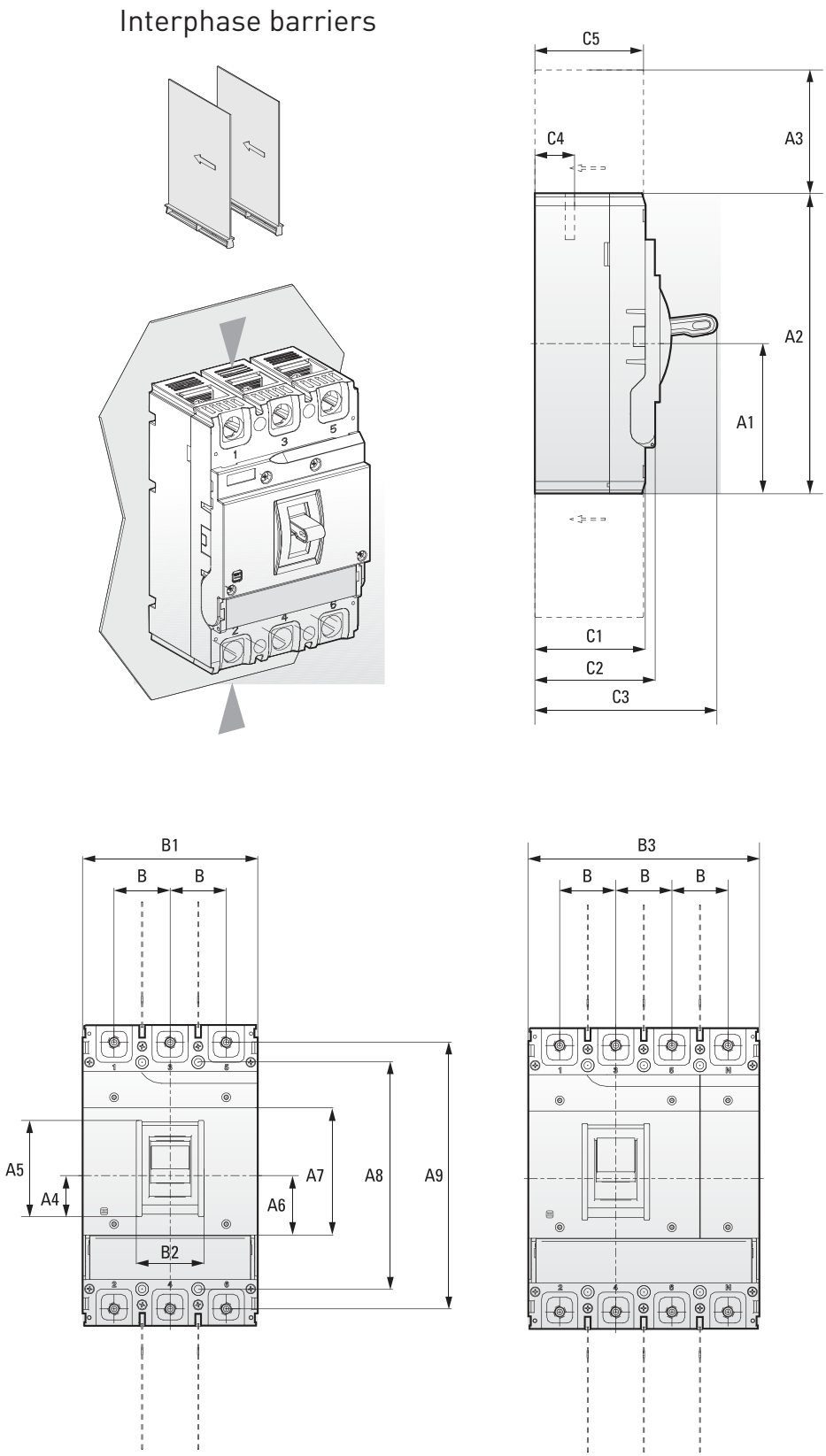
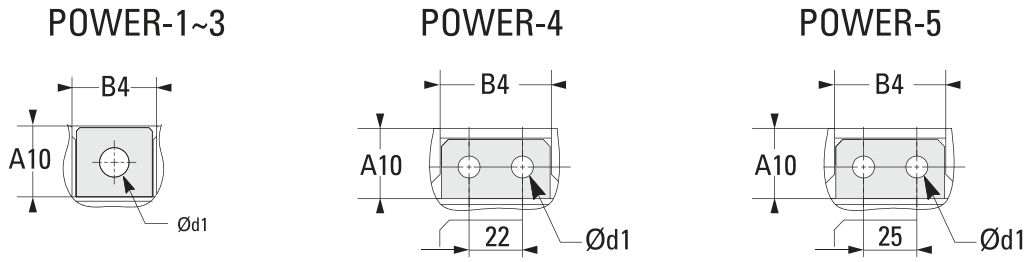
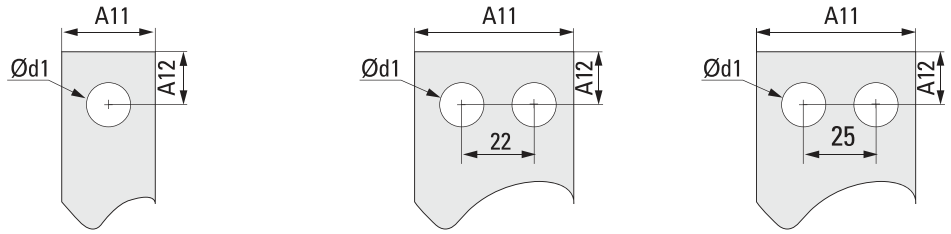


Fig. 3 - Overall dimensions of AV POWER-1 (2) (3) (4)

Terminals



Cross- section of the conductor



Installation dimensions

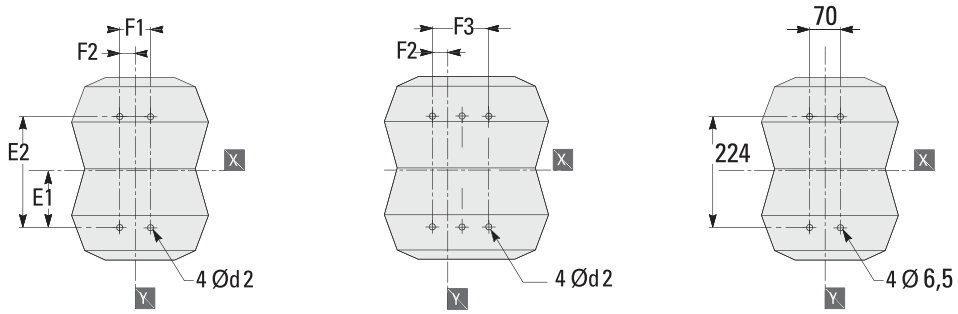


Fig. 4 - Connection dimensions

Table 20

Model	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
Power-1 TR	65	130	50	20,9	29,7	29,5	54,5	111	116	15,8	13	7
Power-1 ETU, TR80kA	77,5	155	50	22,5	42,6	28	58	132	137	17,8	13	8,5
Power-2	82,5	165	80	21	47,5	28,5	62	143	144	20,5	24	10
Power 3	128,5	257	105,8	35,2	82,5	51	109	194	228	28,5	30	13
Power-4	137,5	275	110	37,9	81,8	51	102	243	243	29	45	13
Power-5	143,75	287,5	107	–	130	–	189	224	258,5	30	50	15,5

Table 21

Model	B	B1	B2	B3	B4	C1	C2	C3	C4	C5
Power-1 TR	25	77	24,5	102	18	56	61	81,5	18	55
Power-1 ETU, TR80kA	30	92	28,5	122	18	72	79	101	23,5	73
Power-2	35	105	32,6	140	24,5	66	73	99,5	24,6	65
Power 3	48	150	58	198	32	94,5	103	151,5	26	93
Power-4	70	210	61,5	280	46	97	105	156,5	25	93
Power-5	70	216	75	–	51	137	158	232	32,5	–

Table 22

Model	E1	E2	F1	F2	F3	d1	d2
Power-1 TR	55,5	111	25	12,5	50	6,5	4
Power-1 ETU, TR80kA	66	132	30	15	60	6,5	4,5
Power-2	71,5	143	35	17,5	70	8,5	4,5
Power 3	97	194	48	24	96	11	7
Power-4	121,5	243	70	35	70	9	7
Power-5	–	224	70	–	–	M10	6,5

5 SCOPE OF DELIVERY

The molded case circuit breakers are supplied in one group package. For all available documentation, scan the QR-code on the insert or on the inside of the package.

6 MOUNTING AND CONNECTION

The molded case circuit breakers shall be installed and connected by qualified electrical personnel. Before mounting, make sure, that there are not any external damages.

For the 1-st size, AV Power-1/3 80kA TR, accessories marked «for ETU» shall be used.

Connection options with copper and aluminum wires are supported. Do not connect copper and aluminum wires to one terminal concurrently.

Minimum permissible safety areas up to the molded case circuit breaker.

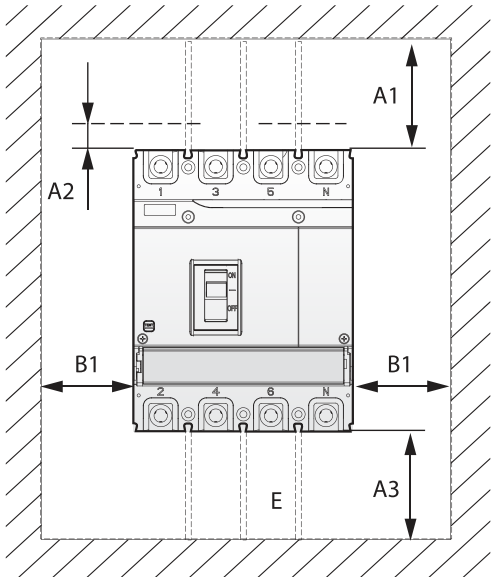


Fig. 5

A1: Upper distance to conducting surfaces (including ground busses).

A2: Upper distance to non-conducting surfaces.

A3: Lower distance from the molded case circuit breaker terminal to the lower surface.

B1: Distance from the molded case circuit breaker to the side surface (including the ground busses).

B2: Distance between the molded case circuit breakers.

Note: E – Interphase barriers shall be installed.

Table 23

Model	**A1**	**A2**	**A3**	**B1**
Power-1	50	25	25	25
Power-2	80	25	25	25
Power 3	106	25	25	25
Power-4	110	25	25	25

Mounting methods of additional accessories depend on the type of the devices. Auxiliary and alarm contacts, as well as trip units shall be installed in special sockets behind the dummy panel, which is mounted with the screws to the housing of the molded case circuit breaker. The conductors from these accessories shall be led to the housing of the molded case circuit breaker from the sides through special sockets. The extended rotary handle and motor mechanism shall be mounted to the housing of the molded case circuit breaker. The communication modules and the indication and programming module shall be installed separately from the molded case circuit breaker and connected to it with the wires from the kit.

7 TRANSPORTATION AND STORAGE

7.1 The molded case circuit breakers can be transported by any means of enclosed transport that ensures protection of packed products against mechanical and atmospheric impacts.

7.2 The molded case circuit breakers shall be stored indoors in the original package at the ambient temperature from -60 to +40 C. The relative humidity is 50% at high temperatures and 90% at low temperatures.

8 MANUFACTURER'S WARRANTY

The manufacturer guarantees that the molded case circuit breaker corresponds to the requirements of IEC 60947-2:2016 provided that the consumer follows the operating, transportation and storage conditions.

Warranty period: 10 years from the date of sale specified in the product receipt.

Shelf life: 10 years from the date of manufacture, indicated on the package or housing.

Service life: 10 years.

Manufacturer: For information, refer to the product package.

Importer and EKF trademark service representative:
EKF ELECTRICAL SOLUTION – FZCO, Dubai Silicon Oasis, DDP, Building A2, Dubai, United Arab Emirates.

Importer and EKF trademark service representative on the territory of the Russian Federation: ООО «Electroresheniya», 2B Otradnaya Str., bld. 9, 5th floor, Moscow 127273, Russia. Tel.: +7 (495) 788-88-15.

Importer and EKF trademark service representative on the territory of the Republic of Kazakhstan: ТОО «Energoresheniya Kazakhstan», Kazakhstan, Almaty, Bostandyk district, Turgut Ozal st., 247, apt 4.

10 YEAR WARRANTY

9 CERTIFICATE OF ACCEPTANCE

The molded case circuit breaker AV POWER has been approved for operation.

Date of manufacture:

For information, refer to the product package.

Stamp of technical control.